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Original Research Article.

Estimation of Stature From The Length of Coronal Sutures in Cadavers: Delhi study

Shalney Razdan[1], Shyam Sunder Nagpal[2*], Ashish Kumar[3], N K Aggarwal[4], Nadia Razdan[5]

[1]Assistant Professor, Department of Forensic Medicine, World College of Medical Sciences, Jhajjar, Haryana, India (Ex-Senior Resident, University College of Medical Sciences & GTB Hospital, Delhi, India.)
[2]Associate Professor, Department of General Surgery, World College of Medical Sciences, Jhajjar, Haryana, India.
[3]Senior Medical Officer, Department of Forensic Medicine, VMMC and Safdarjung Hospital, Delhi, India.
[4]Professor and Head, Department of Forensic Medicine, University College of Medical Sciences & GTB Hospital, Delhi, India.
[5]Ph.D Microbiology, Research Scientist, Trust Leprosy Mission, Delhi, India.

ABSTRACT

Background: Stature estimation from skeletal remains and body parts is based on the principle that height of an individual has a definite and linear relationship with various body parts and long bones of an individual. Stature may be estimated by means of various anthropometric measurements of the skeleton. Such estimation is based on the relations between skeletal elements and stature.

Materials and Methods: The present study was conducted in the department of forensic medicine, University College of medical sciences, Delhi. The aim of the study was to estimate the stature from the length of Coronal sutures in cadavers. The study consisted of 150 cases brought to the mortuary during the period of November 2011 to March 2013. The measurements included in the study were: 1) Stature & 2) Coronal suture. All the measurements were taken in millimeters and mean of three measurements were taken. Total number of cases, both males and females were divided according to age in nine groups and were subjected to statistical computations.

Results: Stature was measured from vertex of head to the base of heel with the dead body in supine position on the flat hard surfaced autopsy table, with the knee and hip joints extended, and the neck and feet in a same plane. The stature in males varied from 824.01 mm to 1820.01 mm with mean value of 1602 mm and standard deviation being 114.05 mm. The stature in females varied from 1379.01 mm to 1710.01 mm with mean value of 1531.8 mm and standard deviation being 64.105 mm.

Conclusion: There exists a positive correlation between the stature and the length of coronal suture in both males and females.

Keywords: Coronal Suture; Stature Estimation; Linear Regression; Autopsy Table and Instruments.

***Correspondence to:**

Dr. Shyam Sunder Nagpal,
Associate Professor,
Department of General Surgery,
World College of Medical Sciences,
Jhajjar, Haryana, India.

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INTRODUCTION

Identification means the determination of the individuality of a person living or dead. It may be complete or partial. Partial identification means ascertainment of only some facts (eg. race, sex, age, stature, etc) about the identity while the others remain still unknown.[1] In the identification of human remains, stature estimation is a preliminary investigation. Estimation of living stature of an individual from various body parts is considered as an important tool in personal investigation. Stature provides one aspect of an individual's physiognomy, and its determination is one of the important initial steps during forensic analysis of skeletal remains.[2] Stature estimation from skeletal remains and body parts is based on the principle that height of an individual has a definite and linear relationship with various body parts and long bones of an individual. Stature may be estimated by means of various anthropometric measurements of the skeleton. Such estimation is based on the relations between skeletal elements and stature.[3] Twilight in 1894 developed a method of stature estimation which involved the use of complete skeleton. In 1956, Fully improved upon this method by measuring different components of the skeleton that contributes to stature. Fully's

method has shown to be a reliable estimate of stature, however it has the disadvantage of being complicated, tedious and time consuming. As a result of these short comings, it has been suggested that the mathematical method of stature should be used.[4] Recently various studies have been conducted on estimation of stature in forensic anthropology reveals that stature of an individual can be effectively estimated from the segments of the foot[5] footprint and foot. Kanchan[7] et al (2010). derived a universal regression formula for stature estimation from the foot length, while Krishan[8] et al (2010). has reported the effect of limb asymmetry on the estimation of stature. Data to determine stature from skull is scanty worldwide and specially from Indian population. Considering its importance, we planned to study on determination of stature from skull using length of coronal suture.

AIM

Estimation of stature from the length of Coronal sutures in cadavers.

MATERIALS AND METHODS

Place of Study: Department of Forensic Medicine UCMS and Guru Teg Bahadur hospital Delhi.

Inclusion Criteria: Cases brought for medicolegal autopsy to the Mortuary of Department of Forensic Medicine UCMS and GTB Hospital Delhi were studied for taking various measurements. Initial 150 cases were selected randomly on the basis of that all the cases coming on Monday and Thursday were taken till the desired sample size was achieved.

Exclusion Criteria

1. Cases with head injury on the basis of history and external examination.
2. Cases with any congenital or hereditary bony deformity on the basis of history and external examination.
3. Cases with bone diseases on the basis of history and external examination.

Study Design: Cross sectional observational study

Sample Size: Since the coefficient of correlation between Coronal suture and the stature is 0.363 (R) To estimate a difference of 5% of this correlation value, a sample size of 150 cases was taken.

Materials

1. The following instruments and documents were used for the study:
   a) Autopsy table and instruments.
   b) Inquest papers and other related documents.
   c) Flexible Measuring tape
   d) Non extensible thread
   e) Vernier callipers
   f) Standard Autopsy suit and gloves
2. Universal precautions were taken while performing autopsies.
3. Informed consent was taken from relatives.

Methodology: The present study was conducted in the department of forensic medicine, University College of medical sciences, Delhi. The aim of the study was to estimate the stature from the length of Coronal sutures in cadavers. The study consisted of 150 cases brought to the mortuary during the period of November 2011 to March 2013. The measurements included in the study were:

1. Stature
2. Coronal suture

All the measurements were taken in millimeters and mean of three measurements were taken. Total number of cases, both males and females were divided according to age in nine groups and were subjected to statistical computations. Linear regression was formulated separately for males and females and also for total population together to find out if a single equation can be used for the total population or an independent equation will be required separately for males and females for the estimation of stature.

The body was placed in supine position on the flat hard surfaced autopsy table, with the knee and hip joints extended, and the neck and feet in a neutral position. The cadaver length (stature) was measured from the vertex of the head to the base of the heel using measurements available on the autopsy table. The whole thickness of the scalp was incised between the mastoid process over the vertex in the coronal plane. The anterior and posterior halves of the scalp were separated from the skull and then reflected forward and backward. The anterior flap was reflected to a level of 2 cm above the supraorbital ridge. The posterior flap was reflected down to a level just above the occipital protuberance. The temporalis muscle was incised along the superior temporal line on both sides. The soft tissues adherent to the periosteum along the coronal sutures were scraped manually until the suture line over the vertex, the pterion on both sides, bregma, lambda and mastoid angles on both sides were clearly visible. The length of coronal and sagittal sutures was measured using a non-extensible thread and Vernier callipers graduated in millimetres. The following measurement was taken:

Length of coronal suture: one end of the inelastic thread was placed over the right pterion at the junction of the sphenoparietal with the sphenofrontal sutures along the coronal plane to the pterion at the junction of the sphenoparietal with the sphenofrontal sutures on left side and two points were marked, the thread was then placed on vernier callipers and the reading was taken.[4]

A predesigned proforma was used to enter the various data for parameters being studied. Three measurements in millimeters were taken for each parameter to improve the accuracy of reading and the mean of all the three readings were taken. All the measurements were taken, and cross checked to minimize measurements error.

Statistical Methods: Stature was estimated from the length of Coronal sutures by using linear regression analysis.

RESULTS AND DISCUSSION

Efforts are also made to formulate multiplication factors and also to find out if there are any bisexual differences in measurements. The age and sex wise distribution of cases is shown in table 1.

Table 1: Age group distribution of both the sexes

Age group (yrs)	Males	Females	Total
0-10	1	0	1
11-20	13	14	27
21-30	23	27	50
31-40	18	13	31
41-50	14	5	19
51-60	8	5	13
61-70	2	2	4
71-80	2	3	5
Total	81	69	150

STATURE

Stature was measured from vertex of head to the base of heel with the dead body in supine position on the flat hard surfaced autopsy table, with the knee and hip joints extended, and the neck and feet in a same plane. The stature in males varied from 824.01 mm to 1820.01 mm with mean value of 1602 mm and standard deviation being 114.05 mm. The stature in females varied from 1379.01 mm to 1710.01 mm with mean value of 1531.8 mm and standard deviation being 64.105 mm as shown in table 2.

Table 2: Showing measurements of stature in both the sexes.

Stature (mm)	Males Total Males (n=81)	Females Total Females (n=69)
Mean	1602	1531.8
Std. error of mean	12.67	7.17
Std. deviation	114.05	64.10
Minimum	824.01	1379.01
Maximum	1820.01	1710.01

A few studies worldwide have been conducted on stature estimation from the skull. Chiba and Terazawa[9] regressed cadaver length on to three skull variables (skull diameter, skull circumference, and sum of the diameter and circumference) to estimate stature for a Japanese sample. Krogman and Iscan[10] reviewed the use of radiography in anthropology such as calculation of the cranial capacity, Identification by means of sinus pattern and sphenoid sella turcica shape in victims of mass disasters. Patil and Mody[11] used measurements of the skull from lateral cephalometric radiographs for sex determination and stature estimation and derived a regression equation from the length of the skull which they concluded is very reliable in the estimation of stature.

Kalia[12] et al used measurements of the skull from lateral cephalometric radiographs and mesiodistal crown width of the six maxillary anterior teeth to derive regression equation in estimating stature. Introna[13] et al performed somatometry on maximum anterior posterior and lateral diameter of skull and reported the feasibility of obtaining an estimation of stature from the skull through calculating correlation coefficients by multiple linear regression, from young age male samples ranging in age between 17 and 27 years old.

Table 3: Showing measurements of coronal suture in both the sexes

	Coronal suture	
Measurements	**Males (n=81)**	**Females (n=69)**
Mean	225.54	219.18
Std. error of mean	1.567	1.342
Std. deviation	14.10	11.15
Minimum	191.44	200.01
Maximum	276.24	248.01

CORONAL SUTURE

Length of Coronal Suture was measured from the right pterion at the junction of the sphenoparietal with the sphenofrontal sutures along the coronal plane to the pterion at the junction of the sphenoparietal with the sphenofrontal sutures on left side. The length of coronal suture in males varied from 191.44 mm to 276.24 mm with mean value of 225.54 mm and standard deviation being 14.10 mm. The length of coronal suture in females varied from 200.01 mm to 248.01 mm with mean value of 219.18 mm and standard deviation being 11.15 mm as shown in table 3.

ESTIMATION OF SUPINE LENGTH

Linear Regression equations for each gender were derived in each age group using length of coronal suture. The positive value of 'r' (correlation coefficient) suggests that there exists a direct relationship between supine length and length of coronal suture.

The value of 'r' for the total population is 0.324 and so the relationship between supine length and length of coronal suture is moderately correlative. As shown in table no 4 the standard error of estimate for total population is ± 95.03. The results derived from the present study were statistically significant. The linear regression equation Stature (mm) = 1019.22 + (2.473 × length of coronal suture) was derived to estimate the stature from the length of coronal suture in total population. The value of 'r' for males is 0.273 and the standard error of estimate for males is ± 109.72. The linear regression equation Stature (mm) = 1104.172 + (2.207 × length of coronal suture) was derived to estimate the stature from the length of coronal suture in males. The value of 'r' in females is 0.25 and the standard error of estimate for females is ± 62.04. The linear regression equation Stature (mm) = 1214.97 + (1.445 X length of coronal suture) was derived to estimate the stature from the length of coronal suture in females.

As there are few studies that have derived linear regression equations to estimate stature using length of Coronal sutures. The present study was an attempt to estimate the stature of male and female individuals from the length of Coronal suture in cosmopolitian population of Delhi and to compare the reliability of this study with other somatometric measurements of skull.

The correlation coefficient of the length of coronal suture of the present study was similar to that of Rao4 et al where the correlation coefficient was 0.363. The length of the coronal suture length showed less correlation coefficient to estimate stature as compared to somatometry of the skull variables (skull diameter, skull circumference, and the sum of the diameter and circumference) as described by Chiba and Terazawa[9] in Japanese male cadavers.

The authors reported correlation coefficient of 0.43 for estimating stature using skull variables. Ryan and Bidmos6 reported correlation coefficients varying from 0.49 to 0.54 for estimating stature using combination of various parameters of skull variables in South African population, which are greater compared to our present study. According to the study of Kalia [12] et al, the correlation coefficients to estimate stature using combination of skull variables and mesiodistal width of maxillary anterior teeth of Mysorean population varied from 0.38 to 0.56, which are slightly greater than our study. In the present study, the correlation coefficient for the linear regression equation using length of coronal suture length was 0.324. According to Rao[14] et al. the standard error of estimate using length of coronal suture was 5.67cm which are greater than the standard error in our study.

In the present study, the standard error of estimate was 0.95 cm using length of coronal suture. Our results are in accordance with Chiba and Terazawa[9] who reported standard error of estimate ranging from 6.59 cm to 8.59 cm from skull variables, which are greater than the standard error in estimating stature using length

of coronal suture, Ryan and Bidmos[4] reported standard error of estimate for the combinations of various parameters of skull variables, ranging from 4.37 to 4.50 cm, which are greater than the standard error in estimating stature using coronal suture length. As a result of which the correlation coefficient was greater in the above studies when compared to coronal suture length.

Table 4: Showing comparison of regression equations derived using length of coronal suture

Age group	Gender	No. of cases	Regression equations	Std. error of estimate(±) mm	Correlation coefficients	P value
ALL	**Both**	150	1019.22 +2.473 × L	95.03	0.324	0.000
	Males	81	1104.172 +2.207×L	109.720	0.273	0.014
	Females	69	1214.977 +1.445×L	62.04	0.251	0.037

L = coronal suture length

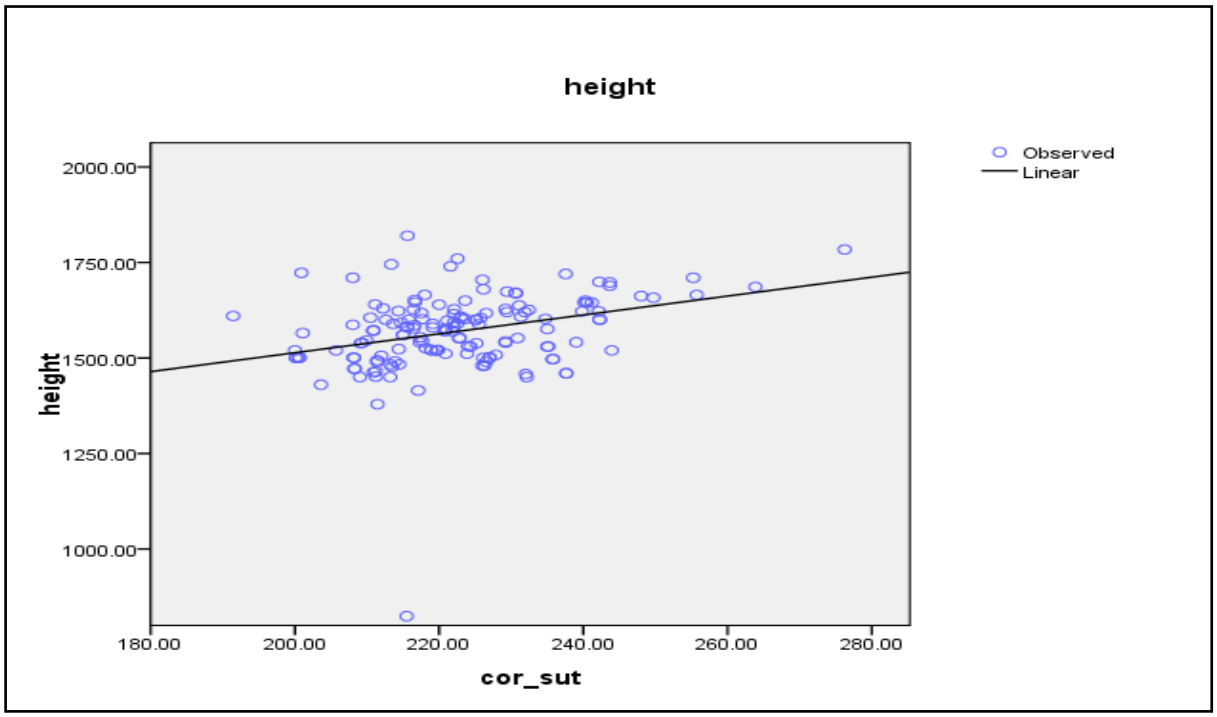

Fig 1: Scatter plot with a linear curve showing relationship between coronal suture length and stature in total population.

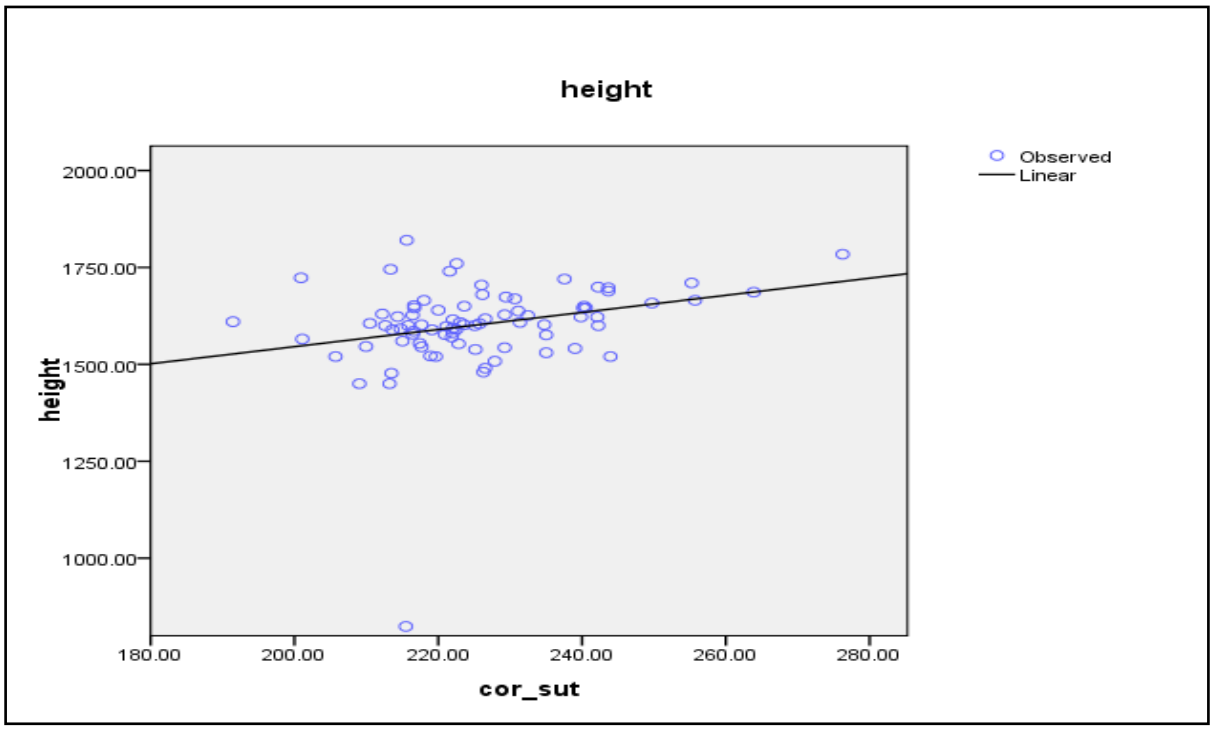

Fig 2: Scatter plot with a linear curve showing relationship between coronal suture length and stature in males.

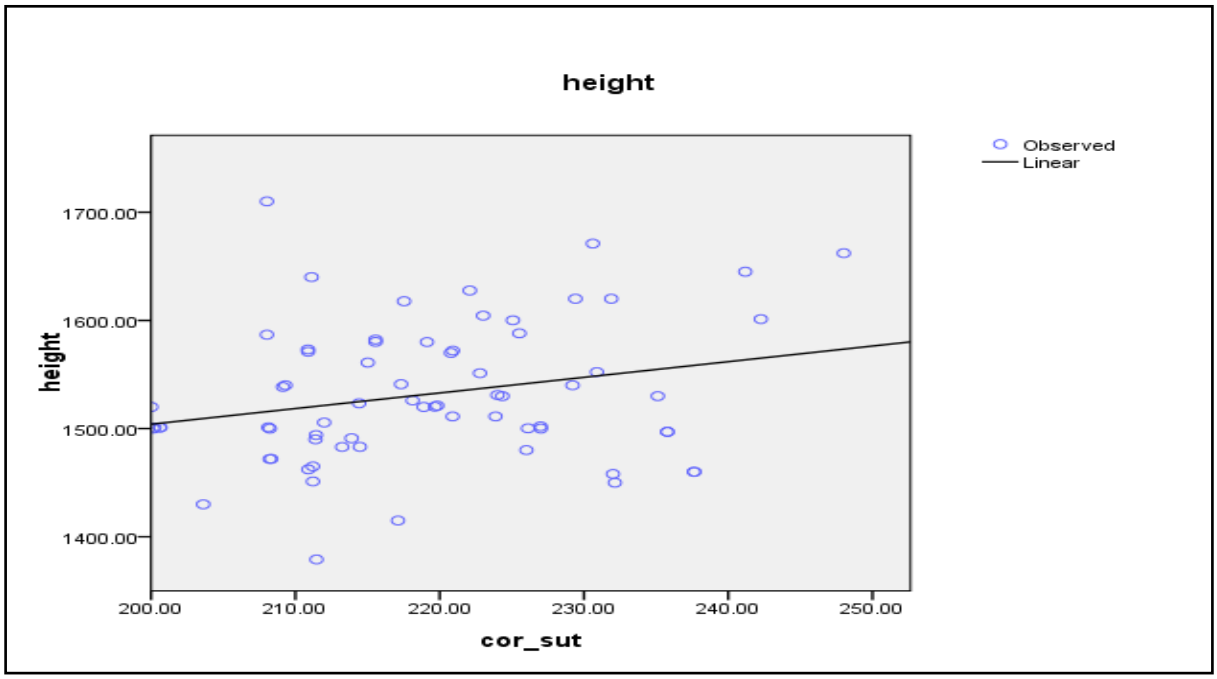

Fig 3: Scatter plot with a linear curve showing relationship between coronal suture length and stature in females.

CONCLUSION

There exists a positive correlation between the stature and the length of coronal suture in both males and females. All the regression equations derived were statistically significant. Therefore, the stature of a person can be satisfactorily estimated by using regression equations derived for that gender.

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